

Université de Montréal
École des Hautes Études Commerciales
École Polytechnique

Université de Montréal
C.P. 6128, Succursale Centre-ville
Montréal (Québec) Canada H3C 3J7

Téléphone: (514) 343-5775
Télécopieur/Fax: (514) 343-5171
e-mail: crr@crr.hec.ca
www.crr.hec.ca/crr/crr.html

CRT-2000-16



Centre de recherche sur les transports (C.R.T.)
Centre for Research on Transportation

***ARC VIEW AND EMME/2 DATA COMMUNICATION
FOR GIS TRANSPORTATION NETWORKS***

by

**Jia Hao Wu
Frank Ji**

May 2000

**PUBLICATION
CRT-2000-16**

***ARC VIEW AND EMME/2 DATA COMMUNICATION
FOR GIS TRANSPORTATION NETWORKS****

by

**Jia Hao Wu^{1,2}
Frank Ji²**

** This research was supported in part by the United States Department of Transportation, Southern California Association of Governments, and by the Natural Sciences and Engineering Research Council of Canada (NSERC).*

¹ Centre de recherche sur les transports, Université de Montréal, C.P. 6128, succursale Centre-ville, Montréal (Québec), CANADA H3C 3J7

² INRO Consultants Inc., 5160, boul. Décarie, suite 610, Montréal (Québec), CANADA H3X 2H9

Dépôt légal – Bibliothèque nationale du Québec,
Bibliothèque nationale du Canada, 2000

ABSTRACT

Urban transportation planning systems (UTPSs) and geographic information systems (GISs) play important roles in social, economic and transportation development. The two types of systems were created to attain different objectives, and contain distinct characteristics. There are many evident benefits of combining the two in real applications. In this paper, we focus on an integration, in terms of data objects and data communication, of the two types of systems, as represented by EMME/2 and ArcView. We establish a relationship among the data objects and then discuss issues of the data communication between them. We apply this method to developing a Windows-based implementation of data communication with Visual Basic. Examples of real networks are shown.

Keywords: GIS, EMME/2, ArcView, urban transportation planning system.

RÉSUMÉ

Les systèmes de planification de transport urbain (UTPSs) et de l'information géographiques (GISs) jouent des rôles importants dans le développement social, économique de transport. Les deux types de systèmes ont été créés pour atteindre des objectifs différents, et contient des caractéristiques distinctes. Il y a beaucoup d'avantages évidents pour combiner les deux dans les applications réels. Dans ce papier, nous nous concentrons sur une intégration, en terme de données d'objets et communication de données de les deux types de systèmes, comme représenté par EMME/2 et ArcView. Nous établissons un rapport parmi les données et alors nous allons discuter sur la communication de données. Nous appliquons cette méthode pour développer une mise en oeuvre Windows-basé de communication de données avec Visual Basic. Des exemples de réseaux réels sont montrés.

Mots-clés: GIS, EMME/2, ArcView, systèmes de planification de transport urbain.

1 Introduction

With the rapid pace of technological development, especially in computer science, we have witnessed dramatic changes in our daily work. Professionals can carry out many projects in various fields in a relatively independent manner. The problems that we are dealing with are increasingly complicated and of ever greater scale. Various activities are interrelated. In December 1991, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA) was made into law in the USA. ISTEA contains the requirement that state highway agencies establish formal information management systems for bridge management, intermodal transportation, pavement management, public transportation, safety, and traffic congestion. Many countries, including Canada, have also started to require the establishment of information systems and a transportation planning process.

Thus, for any transportation management system to be effective, a sound database methodology is required. In this regard, computerized geographic information systems (GISs) are emerging as efficient and effective tools for managing transportation information resources. GIS is a computer-based system that is used to store and manipulate geographic information. This technology has developed so rapidly over the past two decades that it is now accepted as an essential tool for the effective use of geographic information. Its functionality has changed as well. In general, we may consider GIS as a kind of geographical database system. The usual features and capabilities of GIS are: development of layers, data capture (digitized or scan), data storage and retrieval (an editor to store, display and update information), query (query certain features on the screen or label features), display (with color), spatial analysis and cartographic products (thematic maps, etc.)

Historically, a broad range of urban transportation planning system software (UTPS) has been available to transportation planners at the local level. It appears, however, that as concerns the graphics display standards established by new geographic information system software, most of the specialized transportation packages are inherently limited in their general graphical editing and data query capabilities. Conversely, most GISs offer only minimal utilities for transportation analysis.

Developing an urban transportation planning process with a GIS framework promotes standardization. The transportation databases are increasingly being built in GIS, and GIS graphical capabilities greatly facilitate visual analysis of different aggregations. Many regional transportation-planning agencies are adopting GIS technology. Thus there is great need to use GIS and UTPS for any effective study and planning.

In this paper, we discuss various issues of data communication between ArcView (a GIS) and EMME/2 (a UTPS). This paper is a summary of a project that we conducted. In the project, we focused on the data communication between ArcView and EMME/2. We would like to first answer the following questions, which frequently arise in practice:

1. If we have an EMME/2 databank, can we see information such as auto network and transit lines in ArcView with the corresponding attributes?
2. Are ArcView shapefiles and EMME/2 files presented in a consistent way?

3. Can we add the computed results from EMME/2 into ArcView data files for display purposes?
4. If we have a well-defined transportation modeling network in ArcView, can we export it into an EMME/2 databank for computational purposes?
5. How can we perform the data communication between the GIS and EMME/2 in a user-friendly way?

One of the main objectives of the project is to develop a GUI to perform the data communication on certain defined operations and data, if not on all the data in both databanks.

Geographic Information Systems (GIS) can be defined as an organized collection of computer hardware, software, geographic data, and personnel designed to efficiently capture, store, update, manipulate, analyze, and display all forms of geographically referenced information. In other words, a GIS is a computer system capable of holding and using data describing places on the earth's surface. A GIS includes users, software tools, a geographic database, abstraction, the real world and analysis. A GIS establishes one-to-one relationships between an attribute table and a spatial map (a database with a map display).

ArcView is a sophisticated desktop mapping application that promises to bring the power of geographic analysis to the average PC user. ArcView is built on the concept of spatial data, which is all around us. ArcView's data management and analysis are flexible with regard to how spatial data can be modeled. ArcView provides the user with great flexibility in symbolization and map layout. There are many ArcView features for transportation planners. See Hutchinson and Daniel (1995) for some applications of ArcView.

EMME/2 is computer software designed to help answer transportation planning related questions. The acronym EMME/2 is derived from "Équilibre Multimodal, Multimodal Equilibrium", which refers, in French and in English, to the theory of network equilibrium. This theory underlies the multimodal travel forecasting models that may be implemented using EMME/2, which was developed in the late 70's at the Center for Research on Transportation (CRT) of the University of Montréal. The first version of EMME/2 was developed at the CRT in the early 80's. Since 1986 further development and technical support of EMME/2 have been provided by INRO Consultants. Here we quote from INRO Consultants Inc. (1999):

1. EMME/2 is an interactive-graphic state-of-the-art multimodal urban transportation planning system. It offers the planner a complete and comprehensive set of tools for demand modeling, multimodal network modelling and analysis and for the implementation of evaluation procedures.
2. EMME/2 is also a decision support system which provides uniform and efficient data handling procedures, including input data validation. Its databank is structured to permit the simultaneous description, analysis and comparison of several contemplated scenarios.
3. EMME/2 provides a general framework, supported by a consistent user interface, for implementing a wide variety of travel demand forecasting procedures. These range from the simple implementation of a four-step model to more refined demand models and their integration into multimodal equilibration procedures, via the use of direct demand functions with the road and transit assignments. Various impact analyses and evaluation procedures are easily achieved as well.
4. EMME/2 offers the planner a wide variety of "tools" for the direct comparison of future scenarios which may reflect changes in the road and transit networks or changes in the socioeconomic

characteristics of the urban area studied. Once the data bank is set up, the planner may engage in the planning process with the advantage of instantaneous visualization of input data, results of interactive computations, assignment results and other information retrieved from the data bank.

5. All the data may be entered into the data bank interactively, using the appropriately designed interactive editors which are part of EMME/2, or in batch mode.
6. EMME/2 is a comprehensive package consisting of 50 modules which are subdivided into the following groups: Utilities, Network Editor, Matrix Editor, Function Editor, Assignment Procedures and Results. The package also contains some standalone utilities which, for example, produce printed plots and handle the interface with graphic tablets.

EMME/2 has been used for many applications in more than 50 countries. With EMME/2, it is possible to perform various transportation planning-related computations and analyses. The results can be output in text format, which can then be input into ArcView.

Over the last few years, we have seen an increasing need to establish data communication between transportation planning systems, such as Tranplan, EMME/2, MINUTPS, and GIS systems, such as ArcInfo, ArcView and MapInfo. Following is a list of the systems that have so far been developed:

1. ArcInfo-based Tranplan system
2. ArcInfo-based EMME/2 system
3. ArcView-based Tranplan system
4. ArcView-based EMME/2 system
5. MapInfo-based EMME/2 system
6. TransCAD (simple transportation model).

In all these systems, the GIS is featured as an analysis tool that is used with the power of the urban transportation planning systems.

There are many new models and new algorithms that are being developed in response to new problems and theories. These new models and new algorithms can be established in either existing transportation planning systems, such as EMME/2, or in computer languages such as C, C++ and Visual Basic. In this case, we will focus on the development of new models and algorithms, while the presentation of results will be left to the GIS.

System integration can be achieved by integrating ArcView, EMME/2, MS Access and other tools such as micro-simulation software, for example AIMSUN2 in a GUI (graphic user interface). This interface can be created by using a computer language such as MS Visual Basic.

We may use the feature of ArcView IMS (Internet Map Server) to deploy the computational results from EMME/2 onto the Internet. This is one of the important applications of data communication. It means, for example, that a client in a remote city need not have EMME/2 on-hand in order to view the results produced with EMME/2.

2 Data Models

In this section, we discuss the data object in both GIS (ArcInfo and ArcView) and EMME/2.

2.1 ArcInfo and EMME/2 Network Data Object Relationship

ArcInfo data objects are now a part of the geodatabase concept in the new ArcInfo 8.0.1. Zeiler (1999) recently discussed the new ArcInfo data objects. Lussier and Wu (1997) developed an ArcInfo and EMME/2 interface. The data objects are listed in the following table. The table can be used as a guide to develop data communication between most of the GIS and the transportation planning systems currently available.

Table 1 ArcInfo and EMME/2 Data Models

Physical Objects	Spatial type	ARC/INFO Items	Attributes	EMME/2 Items	Attributes
street	line	Route	<cover>.rat<route>		
street section	line	Section	<cover>.sec<route>		
directed street	line	arc	<cover>.aat	link	network
street segment	line	arc	<cover>.aat	link	network
intersection	point	node	<cover>.nat	node	network
traffic light	point	node	<cover>.nat	node	network
bus route	line	route	<cover>.rat<route>	line	network
bus section	line	section	<cover>.sec<route>	seg, line	network
bus stop	point	point event, node	INFO user-defined table (stop file)	node, line	network
region	area	region	<cover>.pat<region>	zone, group	matrix
traffic analysis zone	area	polygon	<cover>.pat	zone	matrix
O and D point	point	node (center, origin, destination)	<cover>.nat <cover>.pat	centroid, zone	matrix, network
OD matrix	point -point	node-node (center-center)	INFO user-defined table (trip table)	centroid-centroid	matrix
Supply	point	node	INFO center file	centroid	matrix
Demand	point	node	INFO center file	centroid	matrix
turns	point	arc-node-arc	<cover>.trn	turn	network
barrier		barrier	No attributes		
drawing		polyline, patterns	<cover>.pat	polyline, patterns	annotation, demarcation
text		annotation	<cover>.tat	character	annotation

2.2 Implemented ArcView and EMME/2 Data Objects

There are many data objects in both EMME/2 and ArcView. Fourteen data objects (or shape types) are listed in ESRI (1998). Here, for this project, we list the data objects that have been implemented in the interface, from which we can communicate the corresponding data, as seen in Table 2.

Table 2 ArcView and EMME/2 Data Objects

Physical Objects	ArcView	EMME/2
street segment	polyline	link
intersection	point	node
bus route	polyline	line
bus section	polyline	segment, line
bus stop	point	node, line
region	polygon	zone, group
traffic analysis zone	polygon, point	zone, centroid
O and D point	polygon, point	Zone, centroid

3 Data Communication

In this section, we discuss the EMME/2 files and ArcView files used for the data communication. A set of EMME/2 files that we can use is shown in Table 3.

Table 3 List of EMME/2 Files

	EMME/2 filename	Description
Network	d211.in	EMME/2 network data before assignment, which must be punched out from module 2.11 of EMME/2
	road.out	EMME/2 link attributes and/or extra attributes after auto assignment, which must be punched out from module 2.41 of EMME/2
Transit Line	d221.in	EMME/2 transit line data before transit assignment, which must be punched out from module 2.21 of EMME/2
	tran.out	EMME/2 transit segment attributes and/or extra attributes after transit assignment, which must be punched out from module 2.41 of EMME/2
Annotation	annotz	EMME/2 annotation file where $z=a, b, \dots, z$

From a modeling point of view, we define a set of four ArcView shapefiles, where each set of shapefiles consists of up to five individual files (.sbn, .sbx, .shp, .shx, .dbf). Each set of files can be represented by just one shapefile (.shp). ArcView will automatically search for the four other corresponding files. See

Table 4 for the list of ArcView files that are defined for the data communication purpose. Each transportation network is formed with four shapefiles as seen in Figure 1:

1. one for the connectors
2. one for the regular links

3. one for the centroids and
4. one for the regular nodes.

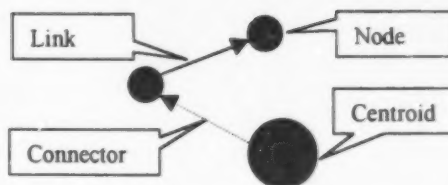


Figure 1 Transportation Network

Table 5 and Table 6 provide samples of files Con_D211.shp (connector file) and Rd_D211.shp (link file) in ArcView. Here each link is identified with I_node and J_node and its attributes such as Len_i (in one direction) and Len_r (in the other direction).

Table 4 List of ArcView Files for AE

	ArcView Shapefile Name	Description
Network	Con_D211.shp	Shapefile for connectors in EMME/2 (Table 5)
	Rd_D211.shp	Shapefile for regular links in EMME/2 ()
	Cen_D211.shp	Shapefile for centroids in EMME/2
	Nod_D211.shp	Shapefile for nodes in EMME/2
	Road.txt	A text file containing regular attributes of links produced from AE as a table for ArcView
	Conn.txt	A text file containing attributes of connectors produced from AE as a table for ArcView
Transit Line	D221_T.shp	EMME/2 transit line data before transit assignment, which must be punched out from module 2.21 of EMME/2
	D221_S.shp	EMME/2 transit segment attributes and/or extra attributes before transit assignment, which must be punched out from module 2.41 of EMME/2
	Tran.txt	A text file containing attributes of transit segments produced from AE as a table for ArcView
Annotation	Annotz.shp	Shapefile for annotations in EMME/2

It is important to note that not all the GIS networks can be used for transportation planning modeling computation. We have seen so many GIS networks where there are no definitions of centroids, nodes, connectors and links. These four spatial features should be ready for transportation planning modeling purposes. Thus before we can start any data communication between ArcView and EMME/2, we have to establish a modeling network. However, the level of detail of the modeling network for EMME/2, such as how many connectors, centroids and links should be defined in advance, is the responsibility of the transportation modeling professionals.

The data communication process can be visualized in the following figure. In fact, we want to establish a user interface to perform the data communication between the ArcView EMME/2 modeling network in ArcView shapefile format and the EMME/2 databank.

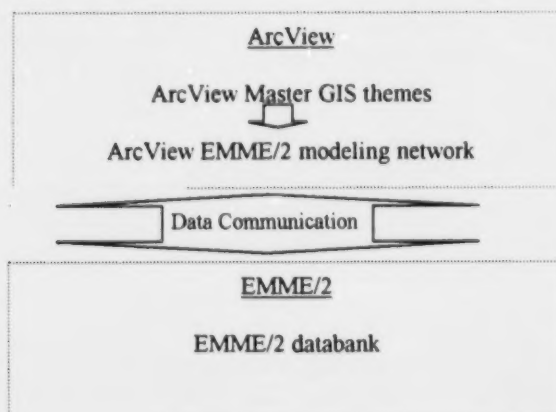
Polyline	ID	Value	Value	Value	Value	Value	Value	Value	Value
4301	4009	0.01000	0.01000	ecgview	ecgview	14	14	9.00000	9.00000
4301	4076	0.12000	-1.00000	ecgview	ecgview	7	7	-1.00000	-1.00000
4301	4099	0.35000	0.35000	ecgview	ecgview	14	14	9.00000	9.00000
4302	4070	0.01000	0.01000	ecgview	ecgview	103	103	9.00000	9.00000
4302	4082	0.11000	0.11000	ecgview	ecgview	103	103	9.00000	9.00000
4303	4027	0.26000	-1.00000	ecgview	ecgview	101	101	-1.00000	-1.00000
4303	4246	1.70000	1.66000	ecgview	ecgview	10	10	0.00000	0.00000
4303	4382	0.14000	0.10000	ecgview	ecgview	117	117	9.00000	9.00000
4303	34003	0.01000	0.01000	ecgview	ecgview	100	100	9.00000	9.00000

Table 5 Con_D211 Table

Polyline	ID	Value	Value	Value	Value	Value	Value	Value	Value
19	31567	6.80000	-1.00000	c	1	10	1	0.00000	-1.00000
20	26215	0.84000	0.84000	ecgview	ecgview	6	6	9.00000	9.00000
21	26436	1.41000	1.41000	ecgview	ecgview	6	6	9.00000	9.00000
22	26175	5.20000	5.20000	ecgview	ecgview	6	6	9.00000	9.00000
23	12142	2.22000	2.22000	ecgview	ecgview	6	6	9.00000	9.00000
24	26296	0.14000	0.14000	ecgview	ecgview	16	16	9.00000	9.00000
24	26337	0.30000	0.30000	d	1	10	10	0.00000	0.00000
24	31567	7.80000	1.00000	c	1	10	1	0.00000	-1.00000
25	26337	0.79000	0.79000	ecgview	ecgview	6	6	9.00000	9.00000

Table 6 Rd_D211 Table

Figure 2 Data Communication Process



4 Implementation

We developed a Windows-based application called AE (ArcView and EMME/2), which is easy to use. We use the text files from EMME/2 and convert them to shapefiles for ArcView. One of the advantages of this approach is that we do not need to use the EMME/2 databank, which can be very large in some cases, as it is for SCAG (Southern California Association of Governments). The following are important considerations when using AE.

- We assume that the data that we communicate are already consistent and correct. Otherwise the extensive error checking features of EMME/2 can find the errors.
- EMME/2 data files such as d211.in and d221.in should be punched out to avoid possible reading errors.
- The conversion of EMME/2 data into ArcView is quite standard, while the conversion of ArcView files into EMME/2 files is not. Here we assume that we are given two shapefiles, that is, the connectors shapefile and the roads (regular links) shapefile.
- Minus one in the tables indicates that the corresponding link or connector does not exist in EMME/2.
- We assume that some connectors in the shapefile, without connecting to the regular links, will be rejected by EMME/2 if the shapefile is converted into d211.in in EMME/2. In any case, these links will not be used in the auto assignment.

The basic features of the implementation are described here:

1. The application is Windows-based. It can be used on a PC where there are ArcView and EMME/2 data files.
2. Users simply follow the instructions provided in the application to perform the data communication.
3. Users can perform various GIS analyses in ArcView for data that are available in EMME/2. Thus knowledge of EMME/2 may not be required.
4. Users can read the link-related information for the auto network and the segment-related information for the transit network.

We chose to use the Microsoft Visual Basic language (VB) for the following reasons:

1. We have extensive experience in using VB.
2. There is a set of excellent database features in VB, which facilitate the implementation of the interface. The ArcView shapefiles do require knowledge of the dBase structure.
3. The programming environment is excellent as well, which makes the debugging process much easier.
4. VB can be used for client and server applications.
5. There are many programmers who have VB experience.
6. VB classes have been developed by ESRI for shapefile manipulation and are available on its Web site.

Binary shapefiles are an important data format in the GIS created by ESRI (ESRI, 1998). ESRI has also created shapefiles for many cities and states in the USA. There are a lot of GIS data available in the

shapefile format in Canada as well. It is interesting to note that the GIS data in shapefile format can be obtained with format translators available from MapInfo and ArcInfo.

A shapefile stores nontopological geometry and attribute information for the spatial features in a data set. The geometry for a feature is stored as a shape comprising a set of vector coordinates. ArcView uses the shapefiles to display the GIS information. Shapefiles can support many types of data formats for point, line, and area features. Area features are represented as closed loop, double-digitized polygons. Attributes are held in a dBASE ® format file. Each attribute record has a one-to-one relationship with the associated shape record.

Shapefiles can be created with these four general methods.

1. Export: Shapefiles can be created by exporting any data source to a shapefile using ARC/INFO ®, PC ARC/INFO ®, Spatial Database Engine ™ (SDE ™), ArcView ® GIS, or *BusinessMAP* ™ software.
2. Digitize: Shapefiles can be created directly by digitizing shapes using ArcView GIS feature creation tools.
3. Programming: Using Avenue ™ (ArcView GIS), MapObjects ™, ARC Macro Language (AML ™) (ARC/INFO), or Simple Macro Language (SML ™) (PC ARC/INFO) software, you can create shapefiles within your programs.
4. Write directly to the shapefile specifications by creating a program.

In this project, we use the fourth method, that is, we write a VB-based program to read from and write to the shapefiles. For each shapefile, there are in fact three associated files: a main file, an index file and a dBASE table. The main file is a direct access, variable-record-length file in which each record describes a shape with a list of its vertices. In the index file, each record contains the offset of the corresponding main file record from the beginning of the main file. The dBASE table contains feature attributes with one record per feature. The one-to-one relationship between geometry and attributes is based on record number. Attribute records in the dBASE file must be in the same order as records in the main file.

The organization of each file and its description is described in ESRI (1998); these are also used to guide the implementation of the interface.

The data files that we use are in general the d211.in (auto network) and d221.in (transit line file) files as text files. For a more detailed description of the two files, please refer to the *EMME/2 User's Manual* (INRO, 1999).

5 Data Communication Interface (AE)

We consider two ways of data communication (AVAndEM2) between ArcView and EMME/2. See where AVToEM2 presents the data flow from ArcView to EMME/2. ModelShpToEMME/2 converts the two shapefiles (connectors and regular links) into d211.in in EMME/2. ShpToAnnots converts the shapefile into an EMME/2 annotation file. EM2ToAV presents the data flow from EMME/2 to Arcview. EMME2ToModelShp converts the d211.in file into shapefiles. AnnotsToShp converts the annotation file into a shapefile. AttstoModeDat converts the annotation output file of EMME/2 road attributes into a text file for ArcView. D221toTransitShp converts the transit file of EMME/2 into a shape file. AttstoTransitDat converts the output files of EMME/2 transit segment attributes into a text file for ArcView.

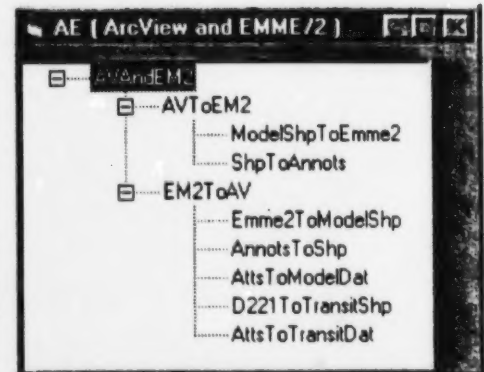


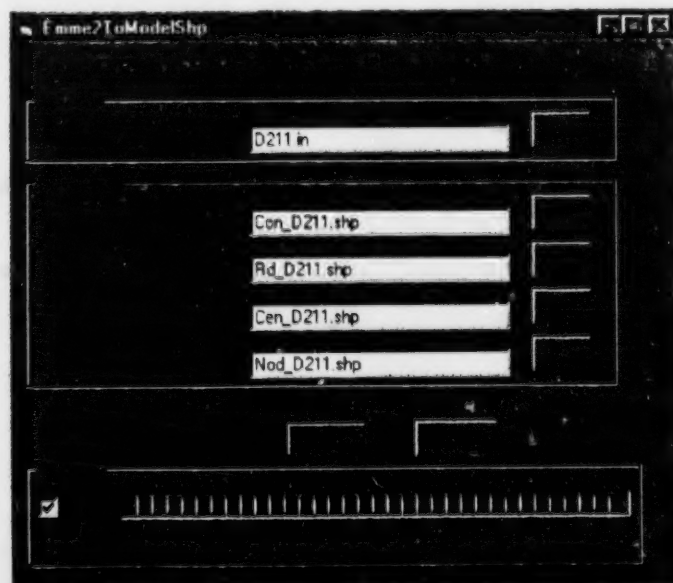
Figure 3 AE Interface

It is noted that, as time goes on, it is always possible to add more functions to the interface.

5.1 From EMME/2

In this section we provide the steps for converting EMME/2 data into ArcView. In general, we use the interface to show the steps of the conversion process, with some illustrations whenever necessary.

5.1.1 Auto Network File



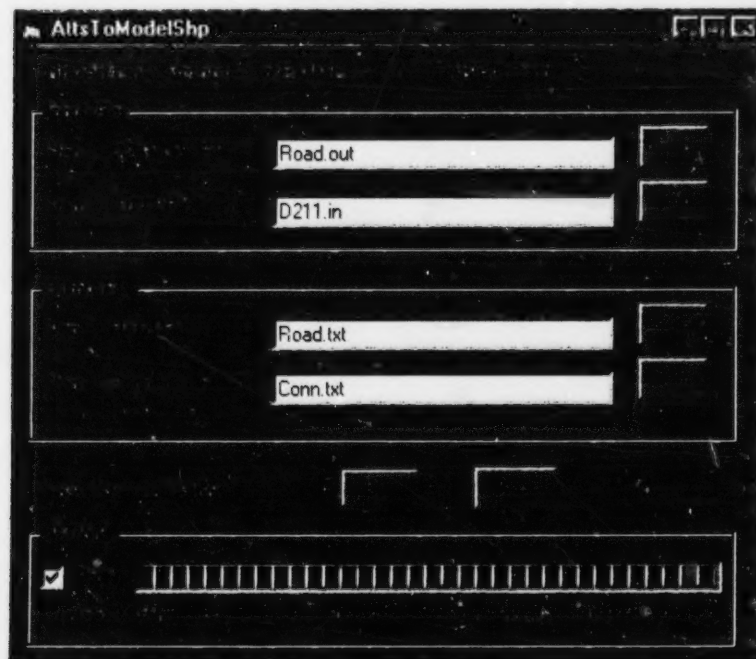
5.1.2 Auto Attribute File

Step. 1 Goto 2.41 (in EMME/2)

Step. 2 Output link attributes of interest (in EMME/2)

Step. 3 Modify the output name such as road.out (outside of EMME/2)

Step. 4 Convert it into a text file for ArcView such as road.txt (as follows in AE)



Step. 5 Add the file into ArcView (in ArcView)

Step. 6 (Optional) Create a new field, say ID, in the last field (a string with a width of 12 in ArcView)

Step. 7 (Optional) Use Field->Calculate to compute the field string as "-+[I-node].asstring+"-
"+[J_node].asstring (in ArcView)

It is noted that Step. 6 and Step. 7 are usually done in AE already.

Step. 6. Join the files together (in ArcView)

5.1.3 Transit File

The file d221.in has to be punched out from EMME/2. Otherwise AE may not read it correctly.

The screenshot shows a dialog box titled "D221ToTransitShp". It contains several input fields and checkboxes. The first section has two input fields: "d221.in" and "D211.in". The second section has two input fields: "d221_T.shp" and "d221_S.shp". The third section has a checked checkbox and a progress bar.

D221ToTransitShp

d221.in

D211.in

d221_T.shp

d221_S.shp

☒ [Progress Bar]

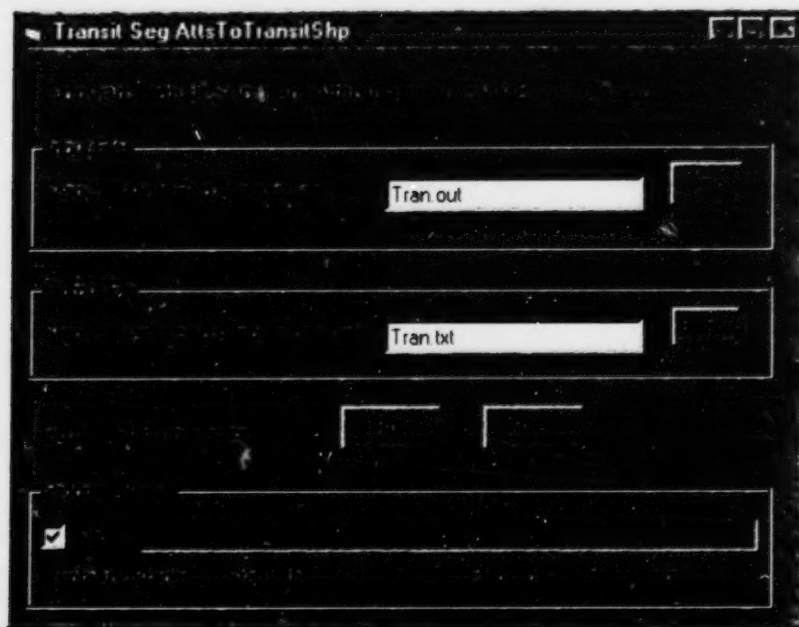
5.1.4 Transit Attribute File

Step. 1 Goto 2.41 (in EMME/2)

Step. 2 Output segment attributes of interest (in EMME/2)

Step. 3 Modify the output name such as Tran.out (outside of EMME/2)

Step. 4 Convert it into a text file such as Tran.txt for ArcView (as follows in AE)



Step. 5 Add the file into ArcView (in ArcView)

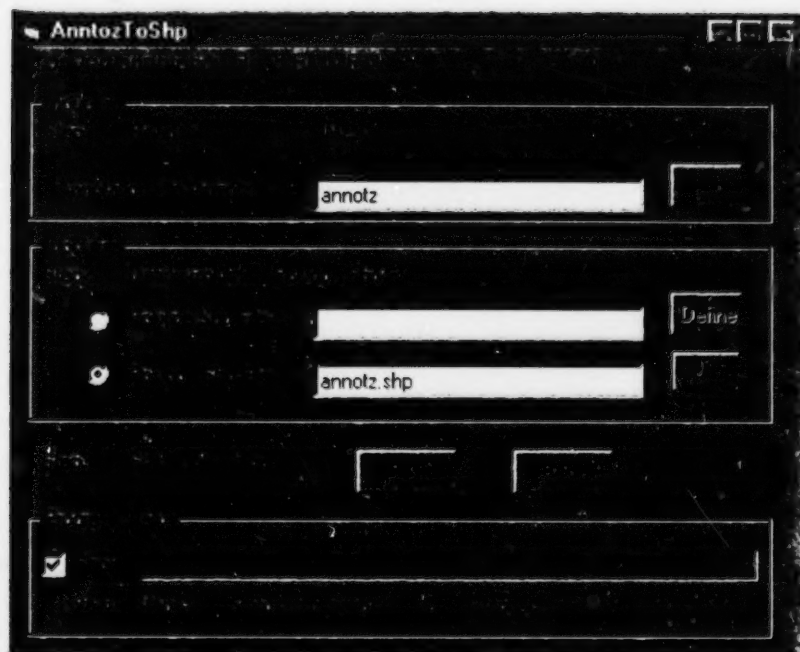
Step. 6 (Optional) Create a new field, say ID, after field J_node (a string with width 12 in ArcView)

Step. 7 (Optional) Use Field->Calculate to compute the field string as "-"+[Line].asstring+[I-node].asstring+"-"+[J_node].asstring (in ArcView)

It is noted that Step. 6 and Step. 7 are usually done in AE already.

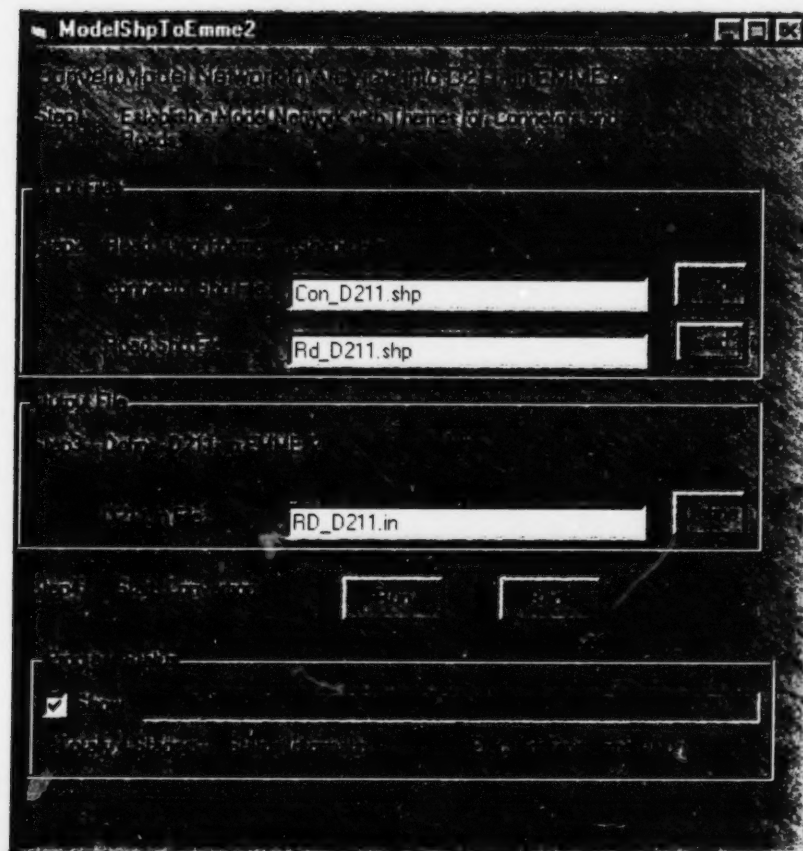
Step. 6. Join the files together (in ArcView)

5.1.5 Annotation File

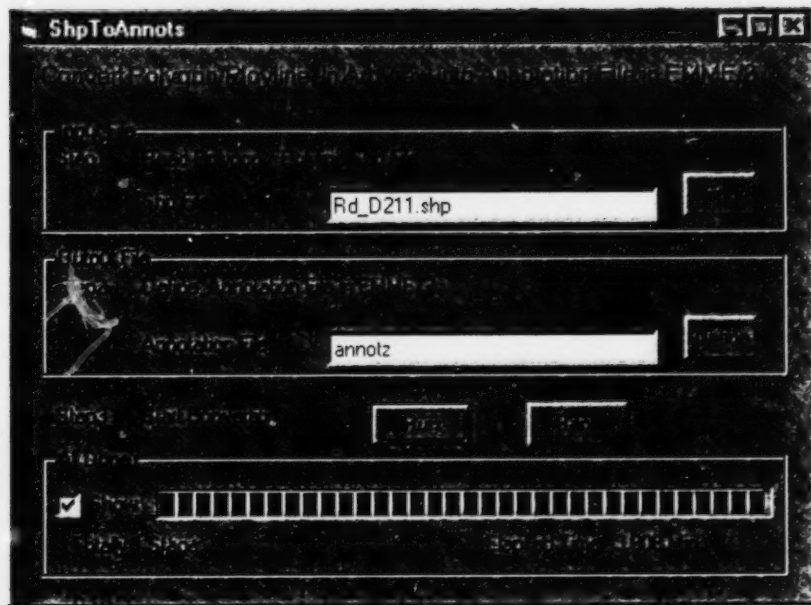


5.2 From ArcView

5.2.1 Road and Connector Shapefiles



5.2.2 Shapefile For Annotation



6 Examples in SCAG

In this section, we provide examples of this project based on information gathered on a real network in Southern California. The statistics of this very large network are listed as follows in the EMME/2 databank:

Highway and Transit Network (AM, scenario 1000 in bank NETWKpk)

22 modes	12 transit vehicle types
3217 centroids	667 transit lines
25430 regular nodes	56716 transit line segments
99867 directional links	

6.1.1 Auto network

We used AE to convert the auto network in EMME/2 into ArcView. Figure 4 shows part of the SCAG-II network in ArcView, where the red dots present the centroids, green links the connectors, blue links the auto links and blue dots the regular nodes. Figure 5 shows part of the SCAG-II network in both EMME/2 and ArcView.

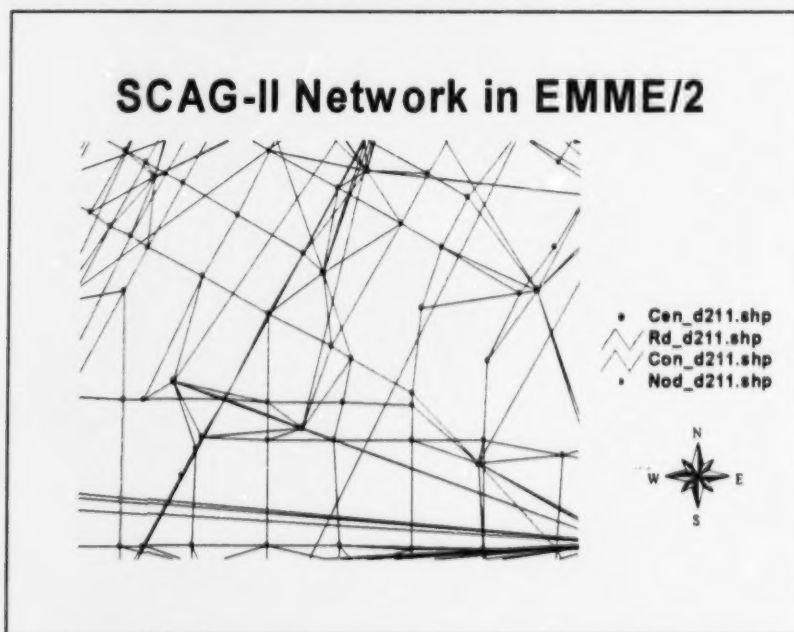


Figure 4 Layouts of SCAG in ArcView (SCAG-II)

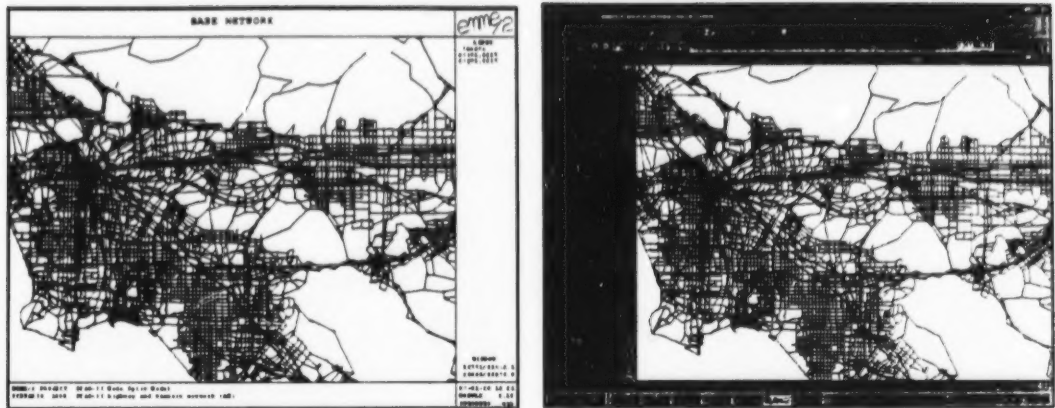


Figure 5 A Partial Network in Both EMME/2 and ArcView (SCAG-II)

6.1.2 Transit Network

Figure 6 shows the transit network. It contains transit lines where the column line represents the line number, i_node and j_node represent the two nodes of one link, and other segment related information.

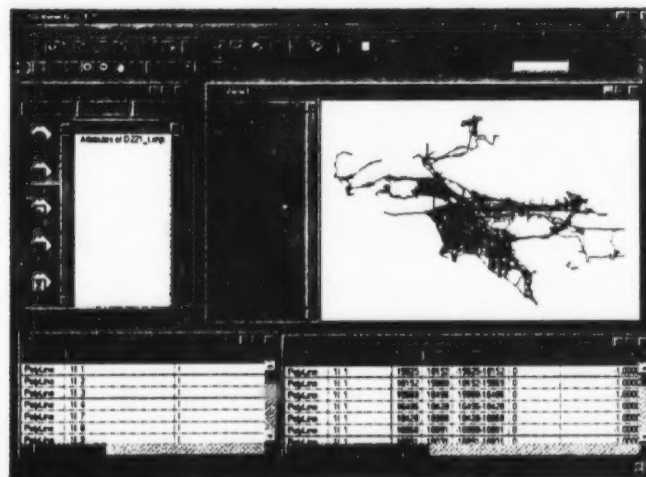


Figure 6 Transit Network in ArcView (SCAG-II)

6.1.3 Auto Speed and Volume

After the auto assignment, we can use module 2.41 (network calculator) to compute the speeds for all the links in ArcView, and then output the speeds and volumes in text format. We use AE to form shapefiles, as shown Figure 7.

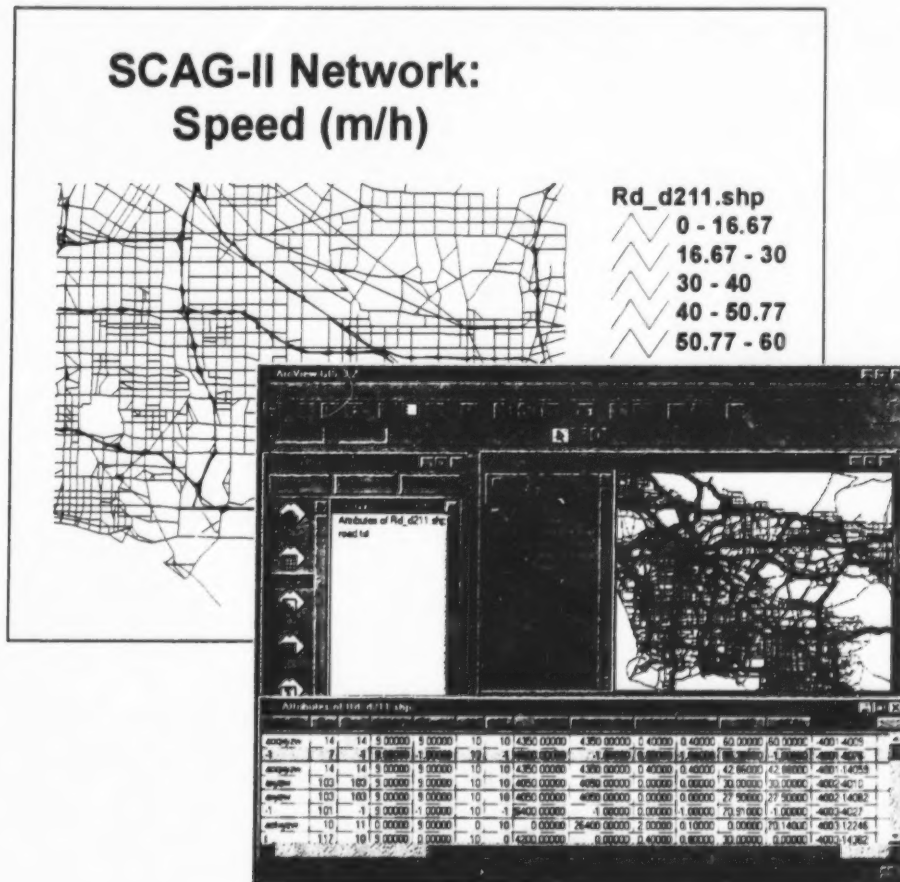


Figure 7 Auto Speed and Volume in ArcView (SCAG-II)

6.1.4 Transit Volume

Transit volumes in EMME/2 can be punched out, and converted via AE to the corresponding shapefile, as shown in Figure 8.



Figure 8 Transit Volume in ArcView

7 Conclusions

In this paper, we discussed the issues of the development of a user interface for data communication between EMME/2 and ArcView. These issues include data objects, data files and the data communication process. Some examples are provided from the network of Southern California. The corresponding computed results can be linked into ArcView as well, and then displayed.

8 References

1. Anderson, L.D. "Applying geographic information systems to transportation planning", Transportation Research Record 1305, TRB, National Research Council, Washington, D.C., 1991, pp. 113-117.
2. Anderson, M.D. and Souleyrette, R.R. "A geographic information-based transportation forecast model for use in small urbanized areas." Presented in Transportation Research Record, National Research Council, Washington, D.C., 1996.
3. Bailey, M. and Lewis, S., "Creating a municipal geographic information system for transportation: case study of Newton, Massachusetts. Transportation Research Record 1364, TRB, National Research Council, Washington, D.C., 1992, pp. 113-121
4. Bates, C.A., and T. Schwetz, "Linking transportation planning and geographic information systems," Proc. 1990 Annual conference of the urban and regional information systems association, Vol. 1, 1990, pp 174-185.
5. Barret, W. "Building a regional transportation model with GIS software", Proc. 1991 GIS for transportation symposium, 1991, pp 117-126.
6. Bennion, O'Neill, W. "Building transportation analysis zones using geographic information systems," Transportation Research Board 1429, TRB, National Research Council, Washington, D.C., 1994, pp. 49-56.
7. ESRI, "ESRI shapefile technical description", ESRI White Paper, July, 1998.
8. Hartgen, D. and Li, Y. "Geographic information systems applications to transportation corridor planning", Transportation Research Board 1429, TRB, National Research Council, Washington, D.C., 1994, pp. 57-66.
9. Hutchinson, S. and Daniel, L., Inside ArcView, OnWord Press, 1995.
10. INRO Consultants Inc., EMME/2 User's Manual, INRO Consultants Inc., Montreal, 1999.
11. INRO Solutions Inc., EMME/2 implementation of the SCAG-II model: data structure, system analysis and computation, INRO Consultants Inc., Montreal, 2000.
12. Javid, M., Seneviratne, P.N., Attaluri, P. and Aguilar, J. "Application of geographic information systems in planning transit services for people with disabilities", Transportation Research Board 1429, TRB, National Research Council, Washington, D.C., 1994, pp. 40-48.
13. Lussier, R. and Wu, J.H. (1997), "Data exchange between ARC/INFO and EMME/2", Proceedings of the Sixteenth Annual ESRI User Conference.
14. Miller, H. J. and Storm, J.D. "A GIS-based simultaneous transportation equilibrium model," Presented in Transportation Research Record, National Research Council, Washington, D.C., 1996.
15. Harper, E., and Chem, W. "Development of a prototype GIS for transportation modeling", Presented at 3rd Conference on transportation applications, Dallas, Tex, 1991.

16. Patterson, P.E. "An evaluation of the capabilities and integration of aggregate transportation demand Models with GIS technologies," Proc., 1990 Annual conference of the urban and regional information systems association, Vol. 4, 1990, pp. 330-342.
17. Prastacos, P. "Integrating GIS technology in urban transportation planning and modeling," Transportation Research Record 1305, TRB, National Research Council, Washington D.C., 1991, pp-123-130.
18. Shaw, S. "Design considerations for a GIS-Based transportation network analysis system," Proc. GIS/LIS '89, Vol. 1, 1989, pp. 20-29.
19. Van Est, J.P., and M. Sliepen, "GIS and transportation modeling partnership," Transportation planning and research Symposium, The Hague, The Netherlands, 1990.
20. Zeiler, M. (1999), Modeling our world: The ESRI Guide to Geodatabase Design, ESRI Press, Redland.